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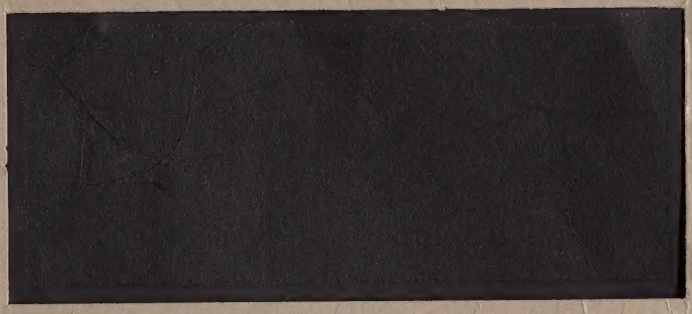

ALFRED ELECTRONICS 897 COMMERCIAL STREET, PALO ALTO, CALIF.

SWEEPING POWER SUPPLY

MODEL 601A

Serial No. _____

ALFRED ELECTRONICS 897 COMMERCIAL STREET, PALO ALTO, CALIF.

SWEEPING POWER SUPPLY
MODEL 601A

SPECIFICATIONS

HELIX AND COLLECTOR SUPPLY

Voltage: 100 to 3500 volts, negative with respect to chassis. Increases exponentially with time or manual control. Collector voltage may be selected by rear switch for 0 or +135 volts above helix potential.

Current: 0 to 25 ma.

Regulation: .5% zero to full load or 105 to 125 v power input change.

Ripple and Noise: 1 volt max, pk to pk.

Metering: 0 to 4000 volts direct output or log of output, selected by panel switch, 4 1/2" meter, 2% accuracy.
Helix current, 2" meter, 2% accuracy.
Collector current, 2" meter, 2% accuracy.

Protection: Helix overcurrent and Helix-Collector overvoltage relays shut off Helix and Anode supplies. Panel screwdriver control sets overvoltage trip level to any value from 800 to 3700 volts and may be adjusted to prevent overvoltage damage to load from excessive DC and sweep amplitude settings.

Resistors connected across all high voltage capacitors to assure discharge upon removal of power.

With High Voltage switch on, interlock relay prevents high voltage overshoot upon application or removal of power.

Manual Control: Voltage adjustable by 10-turn helipot with duodial.

Selector: Recurrent Sweep, Single Sweep, DC, and DC +60 CPS on panel switch. DC +60 CPS position applies 18 volt pk to pk sine-wave to helix voltage.

Sweep:

Amplitude

Zero to full voltage range, adjustable by panel control.
Sweep starts from DC value and increases voltage.

Time

100 to .1 seconds, selectable by panel switch for 10, 1, or .1 seconds, and X1 to X10 vernier multiplier control.

Control

Hold switch stops sweep at any voltage. Sweep continues upon switch release.
Start switch initiates single sweep.
SPDT relay contacts operate during single sweep.

Monitor Output

Sweep Out positive linear saw tooth, 10 volts peak.
Blanking Out, 60 volts negative.
Panel BNC connectors.

External

Input voltage range +5 to -20 volts.
0 to -20 volts gives 100 to 3500 Helix-Collector voltage.
DC to approximately 300 CPS response.
Input impedance 100 K shunted by 170 mmfd.
Panel BNC connector.

ANODE SUPPLY

Voltage:	5 to 450 volts, adjustable on panel control.
Current:	0 to 5 ma.
Regulation:	2% for 105 to 125 v power input change.
Ripple:	1% max, pk to pk.
Modulation:	Selected by panel switch.

Internal Square Wave

Anode voltage is alternately minimum and operating value.
Frequency 800 to 1200 CPS, adjustable by panel control.

External

0 to -50 volts gives 0 to full anode voltage.
DC to approximately 50 kc response.
Input impedance, 100 K shunted by 65 mmfd.
Panel BNC connector.

HEATER SUPPLY

Voltage:	0 to 10 volts AC, adjustable by panel control.
Current:	0 to 3 amps.
Regulation:	1% line.
Metering:	0 to 10 v on 2" meter, 2% accuracy.

SOLENOID SUPPLY

Voltage:	0 to 100 volts DC, adjustable by panel control.
Current:	0 to 5 amps.
Regulation:	Unregulated.
Ripple:	2% max, voltage pk to pk.
Metering:	0 to 100 v on 2" meter, 2% accuracy. 0 to 5 amps on 2" meter, 2% accuracy.

BLOWER SUPPLY

Voltage:	115 volts AC or approximately 28 volts DC.
Current:	0 to 1 amp.
Regulation:	Unregulated.
DC Ripple:	30% max, pk to pk.

GENERAL

Switching:	Separate POWER and HIGH VOLTAGE panel switches.
Connectors:	Winchester PM6S for TW tube. Barrier terminals for solenoid and blower.
Mounting:	Bench or standard 19" rack. Removal of handle sides permits rack installation. Panel finish, grey hammertone. Height: 19 1/4". Width: 20". Depth: 15"from panel, 16 1/2" overall.
Power Input:	105 to 125 v, 60 CPS, approximately 1100 VA.
Weight:	112 pounds.

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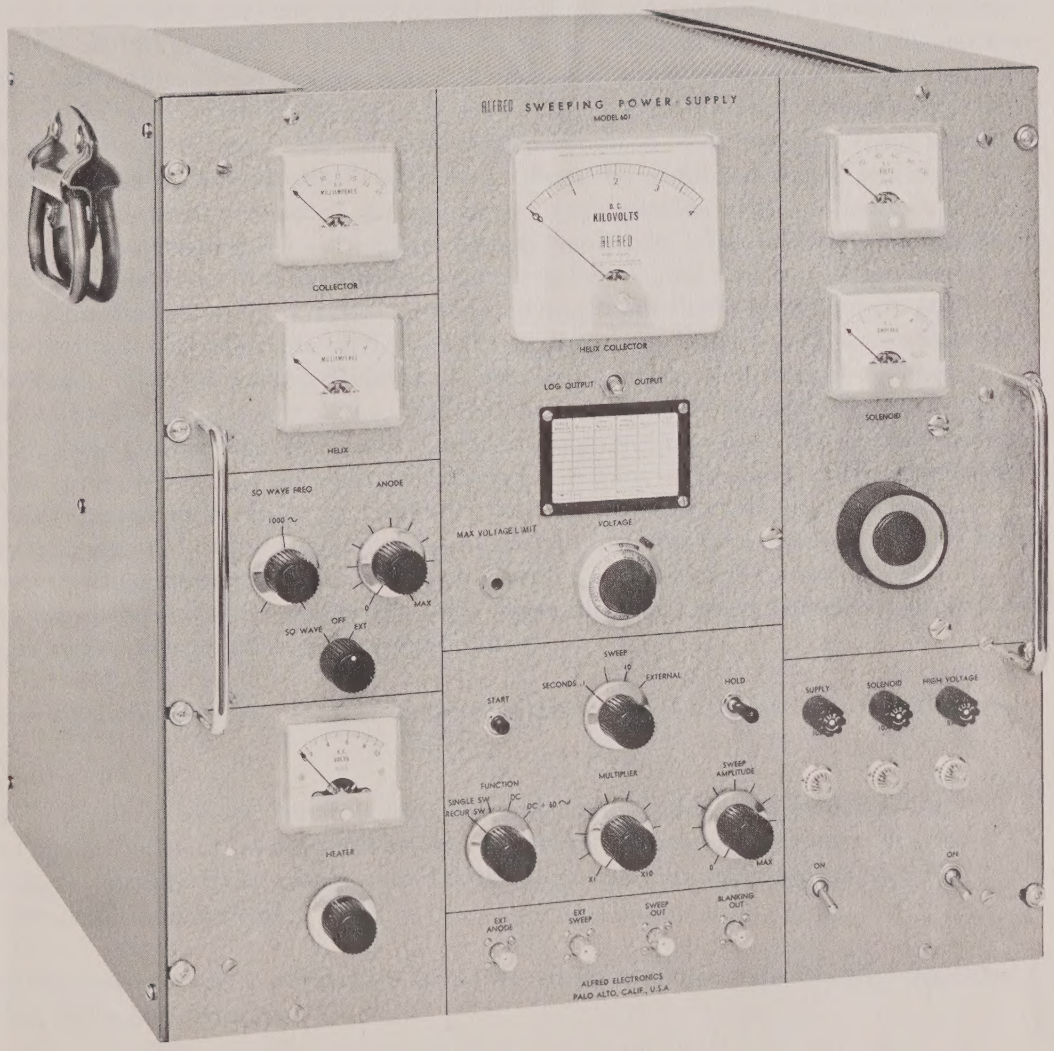


ALFRED Sweeping Power Supply
Model 601

SECTION I -- GENERAL

DESCRIPTION

The ALFRED Model 601 Sweeping Power Supply is a general purpose laboratory source of voltages normally required for operation of many traveling wave tube types. Power is available from the instrument for the TW tube, helix, collector, anode, and heater, as well as solenoid and blower. Special overload circuits included, prevent damage to the TW tube or solenoid from failures or misadjustment.

The Helix-Collector supply employs a non-linear feedback amplifier to provide voltage in the range of 100 to 3500 volts. The non-linearity achieves an exponentially increasing output with linearly increasing input. By means of panel controls the supply may be selected to provide any of four types of output: DC; DC plus a small sinusoidal 60 CPS modulation of helix voltage only; nonlinear amplification of an external input signal; or voltage increasing exponentially with time. Both the amplified signal and exponential sweep can cover the entire voltage range or any portion of it. Independent panel controls set starting DC voltage and sweep amplitude. The 601 is thus particularly useful for variable frequency operation of backward wave and similar voltage-tuned microwave oscillator tubes. Oscillator tubes having logarithmic frequency vs helix-collector voltage characteristic will yield linear frequency output vs time or external input voltage. Thus frequency deviation is also independent of starting frequency. A panel voltmeter may be selected to indicate helix-collector voltage (log frequency) or its logarithm (linear frequency). A linear sawtooth voltage from the internal sweep generator is available on a panel connector to drive external displays. The amplitude varies with the sweep voltage applied to the helix-collector amplifier, and will be directly proportional to the frequency deviation of oscillator tubes having a logarithmic frequency-voltage characteristic. The sweep may be single or recurrent at rates suitable for either a chart recorder or oscilloscope display. Relay contacts are provided for single sweep control of an external recorder.

Collector potential may be selected by rear switch to 0 or +135 volts relative to the helix.

The anode supply provides 5 to 450 volts DC and may be modulated by either the internal square wave or an external source. External connection has response from DC to approximately 50 kc and permits feedback of detected oscillator output for automatic amplitude control.

The heater power source is adjustable from 0 to 10 volts and is magnetically regulated for stable TW tube operation.

The solenoid supply provides 0 to 100 volts well filtered DC for low focusing modulation.

Both 115 volt AC and 28 volt DC power is provided for appropriate blower.

The 601 is built as a convenient laboratory bench instrument. However, simply by removing outside sheet metal sides it may be mounted in a standard relay rack.

GENERAL

To provide power for operating TW or BWO tubes, the Model 601 has separate power outputs for helix, collector, anode, solenoid, and blower. A block diagram of the electrical arrangement is indicated in Figure 1. The helix-collector output is negative with respect to chassis ground. The cathode of the external tube thus operates at full negative voltage and the anode is positive to the cathode. The heater source is insulated for full DC voltage. Collector may be operated at either ground or positive potential.

The helix-collector supply is basically a direct coupled non-linear feedback amplifier capable of 100 to 3500 volts output. The nonlinearity is produced by a group of diodes in the feedback path, so arranged that with a linear increasing input voltage the amplifier approximates with line segments an exponential output. A DC voltage, adjustable with a panel 10-turn potentiometer, fed to the amplifier input yields DC output. A function switch also permits connecting either recurrent or single sweep voltage of adjustable amplitude to the input. The resulting sweep starts at the DC level setting and increases output voltage. An external sweep connection may also be used to drive the amplifier with any other waveform desired.

The panel voltmeter may be selected to indicate either the amplifier input or output voltage. Due to the amplifier exponential characteristic, meter indication for the two positions is related by the equation:

$$E_{output} = 100e^{.00102\, E_{log\ output}}$$

The input voltage is thus the logarithm of the output and is so labeled on the panel.

Overcurrent and overvoltage relays cause a second relay with holding contacts to turn off the anode and helix-collector voltages. The holding relay may be reset by turning off the power switch. Overvoltage trip level may be adjusted by a panel control to a safe value within load rating.

A position on the function switch connects an 18 volt pk to pk line frequency sine wave in series with the helix terminal. The small amount of symmetrical frequency deviation produced during essentially CW operation permits precise BWO frequency identification, using an oscilloscope to observe an absorption wavemeter response.

Output from a magnetically regulated transformer is rectified and filtered to provide +135 volts for TW or BWO tubes requiring collector potential positive with respect to helix.

The anode supply employs a 5 mc carrier system so that it may be isolated from ground by full helix-collector supply voltage and still be externally modulated with a signal relative to chassis ground. It consists of a power oscillator, modulated by a DC amplifier, transformer coupled to a rectifier filter, and cathode follower. A multivibrator provides a square wave available for internal modulation.

FUNCTION OF CIRCUITRY

Helix-Collector Supply

Referring to the circuit diagram, the helix-collector voltage is obtained from the output of a high gain, feedback DC amplifier employing V20, V21, V12B, V22 and V23. V20 is a differential amplifier which, due to the high gain of the entire amplifier, operates so that the sum of the voltages on the grid of the left half is the same voltage as the grid of the right half -- in this case ground potential. The amplified difference at the plates of V20 is fed to the grid and cathode at right half of V21. The left half at V21 operates as a cathode follower to drive the cathode of the right half. The amplified signal at the plate of V21 right half is fed to a cathode follower, V12B. The voltage regulator tube V22 in its cathode circuit shifts the DC level, and the resulting signal is fed to the grid of output power amplifier V23.

The feedback impedance consists of the series resistors R51, 80, 81, 90, 91, 92, 93, 94 and 95, paralleled by C26, and connected from the -100 to -3500 high voltage line to V21 grid.

The input voltages on the grid of V20 are from the VOLTAGE potentiometer R1 connected to the +300 volt supply and the SWEEP AMPLITUDE potentiometer R10. The amplifier produces a negative high voltage output divided by the series feedback resistors so that the total voltage on the input grid of V20 remains zero. As input voltage is increased positively, the output becomes more negative and would be a linear function of the input except that the biased diodes V1, V2, V3 and V4 successively conduct. These diodes shunt part of the feedback current and require the output voltage to increase additional amounts to maintain the grid voltage balance. The values of the diode cathode resistors are chosen to achieve, with line segments, a close approximation to an exponential output.

Voltage from the arm of SWEEP AMPLITUDE control R10 is attenuated by R39 and R40 and fed to the grids of both halves of V27 connected in parallel as a cathode follower. Panel SWEEP OUT receptacle S8 is connected to the cathodes of V27 to obtain a positive linear sweep voltage of 10 volts peak.

Panel 4 kv voltmeter M1 may be switched to either the high voltage exponential output through its multiplier resistance, or to V13A through R110 and R111. V13A operates as a cathode follower and samples the feedback voltage proportional to the input voltage. A pre-set potentiometer R112 provides balance voltage to voltmeter M1 for a zero LOG OUTPUT indication when output voltage is 100 volts. Relay RY1 shorts the meter to prevent a negative indication when the high voltage is turned off.

FUNCTION switch SW2 permits operation with single or recurrent sweep input, DC only, or DC + 60 CPS helix voltage variation. On the latter position 6.3 volts rms AC from ZZ winding of transformer T10 is added in series with helix current meter M3 to give 18 volt pk to pk symmetrical modulation about the DC value.

If helix current exceeds approximately 5.0 milliamperes, the contacts of overcurrent relay RY2 operate to close RY3. Although RY2, itself, operates on

approximately 1.25 ma, shunt resistor R17 causes tripping to occur at the 5 ma level. When operated, a set of contacts on RY3 removes the screen voltage from V23, the +300 volts from the plates of V6, and keeps the coil energized. A second set removes primary voltage from high voltage transformer T11. Loss of the +300 volts on V6 drops screen voltage of V7 to a negative value, stopping oscillations and hence anode voltage. Resetting is accomplished by turning off the SUPPLY switch SW9 to de-energize holding relay RY3. Reapplication of power will restore operation unless overload still exists.

Current in resistors R96, R97, R98, R99, R131 passes through the coil of overvoltage relay RY6. When Helix-Collector voltage exceeds a predetermined value, current is sufficient to close RY6 contacts. RY3 is thereby actuated to shut-off high voltage. Again SUPPLY switch must be turned off and on to restore operation. RY2 coil operates at 1.25 ma but it is shunted by panel MAXIMUM VOLTAGE limit potentiometer R3 and resistor R2 to permit adjustment of Helix-Collector overvoltage trip level.

Regulated output from T7 is rectified by SR4 and filtered by capacitor C43 to obtain +135 volts relative to chassis ground. Rear selector switch SW-10 permits connection of pin F of output socket S6 to either chassis ground or the +135 volts. Pin F is the collector connection for the external tube.

Sweep Generator-Amplifier

For swept operation of the Helix-Collector supply a linear sawtooth voltage is provided by an amplifier consisting of V9 and V12A operating as a clamped integrator. A constant current, the magnitude of which is controlled by multiplier control R14, charges the timing capacitor, C1, C2, C3, selected by SWEEP time switch SW6. The voltage across the sweep time capacitor increases linearly until the thyratron V10 fires, discharging the capacitor. The rising voltage at the cathode of V12A is applied to the plate of V10 and a fraction of it to the grid by resistors R63, R64 and R65. When the sweep voltage reaches +150 volts, the grid of V10 passes through approximately zero volts and V10 conducts. If the FUNCTION switch SW2 is in RECURRENT position, the discharge continues until V10 extinguishes, allowing charge interval to restart. V10 then remains off while grid rises from negative value towards zero. Operating the HOLD switch SW5 stops charging current and the sweep.

If the FUNCTION switch SW2 is in the SINGLE SWEEP position, V11 fires near the end of the flyback time, drawing current through V10, forcing it to remain conducting. V11 current also passes through the coil of RY7, actuating the contacts. When the START button is depressed, V11 is turned off and V10 is allowed to extinguish. Current in RY7 then drops to its normal level, which is less than release value. The normal sweep cycle then starts and will again stop during the flyback portion if the start button is released. A portion of the linear sweep is fed, through cathode follower half of V27 to SWEEP OUT connector S8. On DC or DC + 60 CPS position, the FUNCTION switch connects the sweep generator for single sweep operation.

The sweep is also differentiated by R105 and R106, C4, C5 or C6 and applied to cathode follower V13B to provide a negative blanking signal of approximately 60 volts during the flyback portion of the sweep. The capacitors are switched to

compensate for differing flyback times at various sweep rates. The blanking signal is brought out on BLANKING OUT panel connector S7.

When SWEEP switch is placed in EXTERNAL position, resistors R11 and R12 are connected as feedback and input resistors for V9 and V12A. Thyratrons V10 and V11 are also disconnected. V9 and V12A therefore operate as a direct coupled feedback amplifier with a gain of approximately 7.5. Application of -20 volts to the EXT SWEEP input S5 therefore is amplified to +150 v, which is sufficient to drive the helix-collector supply to full output. Frequency response of the entire supply to external signals is DC to approximately 300 CPS.

Anode Supply

The anode voltage is derived from cathode follower V26, driven by the filtered output of voltage doubling rectifier V8. Power to V8 is supplied through isolation transformer T9 from oscillator V7 which is screen grid modulated by DC feedback amplifier V6. A negative voltage from panel ANODE control R9 is connected to the input of V6 and sets DC output voltage of the anode supply. Internal square wave is produced by multivibrator V5. The frequency may be varied from 800 to 1200 CPS by panel control R7. In addition to the DC level voltage from R9 either the square wave from V5 or an external modulation signal applied to panel connector S4 may be connected to V6 by panel switch SW3.

Carrier frequency is approximately 5 mc, permitting the filter to adequately reject carrier ripple and still give good 1000 cycle square wave response. Capacitor C22 is adjusted to resonate L2 at carrier frequency for maximum attenuation. Because anode requirements are for high voltage at low currents circuit impedance is relatively high. Best high frequency response, therefore, is obtained with external anode circuit capacitance kept below 100 mmfd.

Heater Supply

Heater voltage is provided by adjustable transformer T1 powered by magnetically regulated transformer T7 to reduce the effect of line voltage changes on cathode emission. Transformer T3 reduces voltage with adequate DC insulation. Transformer T2 permits direct voltage measurement without having to insulate meter M4 from panel.

Solenoid and Blower Supplies

Solenoid voltage is available on rear terminals 8 and 9 of TS3 and is supplied by a bridge rectifier SR3 and filter L 1, C45, and C46. Variable transformer T 14 permits zero to full voltage adjustment for optimum focusing.

Relay RY5 controls primary power to the solenoid supply and is operated by 115 volts which may pass through a normally closed thermal switch mounted in the solenoid. Terminals 6 and 7 of TS3 permit switch connection and should be jumpered if not used.

Blower DC voltage is supplied to terminals 4 and 5 of TS3 from a bridge rectifier SR2 fed from a transformer T4 and filtered by C44. Power for a 115 volt AC blower is also provided on TS3, terminals 2 and 3.

Internal Supplies

Associated circuitry with tubes V14, V15, V16, V17, V18, V19 and V25 provides regulated power of +300 and -300 volts. Rectified output from V14 is filtered by C39 and C40, and fed to main series regulator tube V15 which is controlled by amplifier V16 to give 600 volts. A high gain beam power series tube is used to improve regulation. A second regulator arrangement utilizes series tube V25 and amplifier V19 to provide a low impedance center-tap for the 600 volt supply. Reference voltage for both regulator circuits is provided by V17 and V18. Heater voltage of V16 and V19 is obtained from T6, which is supplied by magnetically regulated transformer T7. This reduces the effect of line voltage changes on supply output. Regulated heater power is also fed to tubes V1, V2, V3, V4, V6, V7, V8, V9, V13, V16, V19, V20, V21, and V26 for stable operation.

Screen supply voltage of approximately +130 volts relative to the cathode of V15 is furnished by selenium rectifier SR1 and filter capacitor C41 connected to the output of magnetically regulated transformer T7. This voltage, in adding to the +300 volt line, also provides a total of 430 volts to the plate circuit of anode oscillator V7.

Unregulated high voltage of approximately 5000 volts for the helix-collector power amplifier V23 is provided by transformer T11, half wave rectifier V24, and filter capacitor C30. Resistors R100, R101, R102, R103, R104 serve to discharge C30 when high voltage is shut off. Selenium rectifiers SR4, SR5, SR6 and filter capacitor C31 connected to a secondary tap of T11, provide unregulated 700 volts DC plate voltage for anode cathode follower V26.

Relay RY4 is operated by current from the -300 volt supply. Its contacts control high voltage primary power to T11 and plate voltage to V6. Thus, neither anode nor helix-collector high voltage can be turned on until low voltage supply and hence controlling tubes are operating properly. Should High Voltage switch be left on, no voltage overshoot will occur during warmup.

SECTION III -- INSTALLATION AND OPERATION

INSTALLATION

Immediately upon receipt, carefully unpack and inspect the instrument for damage received from transit. Should any damage be found, follow procedure on "Shipment Damage Claim" page at the end of this Manual.

This instrument is designed for either bench or rack operation in normal ambient temperatures. The Model 601A is normally supplied with sheet metal sides having

carrying handles. If the instrument is to be rack mounted, the screws on each handle side, including those at the edge of the panel, should be taken out and the sides removed. Unit is now ready for inserting into rack. Supports should be provided in the rack to carry the weight of the Model 601A upon insertion or removal.

Primary power requirements are 105 to 125 volts, 60 CPS, 1100 voltamperes. If operation at other voltages or frequency is contemplated, consult manufacturer.

SETTING-UP PROCEDURE

Setting-up procedure for the 601A will depend somewhat upon the type and manufacture of the tube to be operated. With possibly some modification, one should proceed as follows:

1. Before turning on power, set panel controls:
   SUPPLY switch to OFF
   HIGH VOLTAGE switch to OFF
   HEATER control fully counterclockwise
   SOLENOID voltage to fully counterclockwise
   ANODE to 0
   Anode modulation switch to OFF
   Helix-Collector VOLTAGE control fully counterclockwise
   Helix-Collector voltmeter switch to OUTPUT
   SWEEP AMPLITUDE to 0
   FUNCTION switch to SINGLE SW.
2. Connect solenoid, blower, and thermal switch to appropriate rear terminals. Insert tube power plug into rear socket.
3. Turn SUPPLY switch to ON. Note that blower should start.
4. Adjust HEATER to correct voltage, and allow several minutes warmup.
5. Set SOLENOID to appropriate voltage or current.
6. Turn on HIGH VOLTAGE switch, noting that HELIX current meter indication should remain low.
7. Set Helix-Collector voltage to maximum operating value for the load and very slowly adjust MAXIMUM VOLTAGE LIMIT screwdriver control counterclockwise until overvoltage relay trips. Reduce Helix-Collector voltage slightly and operate SUPPLY switch to OFF and then ON again.
8. Set Helix-Collector VOLTAGE to desired value.
9. Slowly increase COLLECTOR current to its rated value by advancing ANODE voltage, and observing that HELIX current should not exceed its allowed maximum. If it starts to exceed this value with below normal COLLECTOR current, solenoid power may need readjustment or the TW tube may require mechanical alignment in its solenoid.

   As an example of alignment procedure, tube-solenoid combinations manufactured by Huggins Laboratories may be adjusted in the following manner:

   Loosen locking screws and orient tube for lowest HELIX current, all the while increasing COLLECTOR current towards rated value with ANODE control. Starting

with the tube approximately in the center of the hole, slowly wobble it with the alignment screws to minimize helix current. Position alternately with both top screws, then both bottom screws, and perhaps one top and one bottom. ADJUST CAREFULLY. DO NOT DAMAGE TUBE CAPSULE BY CRUSHING IT AGAINST SOLENOID. After minimum setting is reached, one screw should be turned, usually causing helix current to increase, and then the null relocated by turning a different screw. Often the new null is lower than the original. If not, reverse direction of turning. Should helix current accidentally exceed 5.0 ma, overcurrent relay will shut off power supply. Operation can be restored by turning POWER switch off and then on again. With care, helix current usually can be reduced to a safe value. Slight rotation and longitudinal positioning of the TW tube may also yield a better minimum. The lower the current, the less chance that gas will be driven from the helix due to high temperature operation. Gas would soon damage cathode emission and render the tube inoperative.

When rated COLLECTOR current can be set with safe HELIX current, tube is ready for operation. However, set screwdriver anode LIMIT control so collector current is at rated value when ANODE voltage control is fully clockwise. ANODE control then will have maximum resolution and any setting should give safe operating currents.

10. Select anode modulation desired.

    If SQUARE WAVE is used, anode voltage is alternately minimum and the value without modulation. Adjust SQ WAVE FREQ as required.

    If EXT ANODE is used, negative input increases anode voltage from the DC level set by ANODE control.

11. Select panel Helix-Collector voltmeter switch for desired indication. When operating Backward Wave Oscillator Tubes with a logarithmic frequency vs helix-collector voltage characteristic, frequency is presented linearly when meter switch is on LOG OUTPUT. On OUTPUT position frequency indication is logarithmic.

12. Select FUNCTION switch to desired mode of operation.

    On RECUR SW or SINGLE SW position Helix-Collector voltage starts from DC level set by VOLTAGE control and increases by an amount set by SWEEP AMPLITUDE control. CAUTION: SWEEP ADDS TO DC VOLTAGE. WHEN ADJUSTING EITHER LEVEL TAKE CARE NOT TO EXCEED RATED MAXIMUM VOLTAGE OF LOAD. However, should this accidentally occur, Helix-Collector overvoltage relay should turn off high voltage, if set according to paragraph 7 above. Turn SUPPLY switch off and then on to restore operation.

    Sweep interval in seconds is the product of SWEEP switch and MULTIPLIER control positions. Single sweep begins when start button is momentarily depressed. It may be stopped at any value by operating HOLD switch and it continues upon switch release.

13. Sweep Relay contacts are available at rear terminals 10, 11, 12. These may be connected for start-stop control of a chart recorder motor or pen during single sweep.

14. Sawtooth voltage at SWEEP OUT connector may be used to drive one axis of an XY recorder or oscilloscope. With logarithmic frequency-voltage TW tubes, presentation will be linear in frequency. Sawtooth voltage and the size of the presentation are constant.

15. For external sweep operation, set FUNCTION switch to either RECUR SW or SINGLE SW and SWEEP switch to EXTERNAL. Input voltage in the range of +5 to -20 volts may be applied to panel EXT SWEEP connector. Sweep range may be adjusted by SWEEP AMPLITUDE Control.

SECTION IV -- MAINTENANCE

ROUTINE

CAUTION: Extremely dangerous high voltage exists in this instrument. Observe the utmost care when checking or making repairs.

Routine maintenance need consist only of testing at regular intervals the tubes to detect marginal performance. All tubes are accessible by removing top dust cover and, where necessary, perforated metal housings. Voltage regulator tubes, if removed for test, should be returned to their original sockets. When changing V17 and V18 select tubes, if necessary, to give the same + and -300 volt supply voltages tabulated on Test Data Sheet at end of this Manual.

Zero reading of Helix-Collector voltmeter when its switch is on LOG OUTPUT may occasionally require resetting due to V13 or component aging. This is accomplished by removing top dust cover plate and adjusting pre-set METER ZERO potentiometer R107. Output voltage should be set to exactly 100 volts when making this adjustment.

Calibration of the Helix-Collector supply non-linear network may require occasional checking. With FUNCTION switch on DC position, Helix-Collector voltmeter readings should correspond closely with the values tabulated below. Cathode resistors of diodes V1, V2, V3, V4 may require checking if error is observed. Lower values increase supply output. The resistance determining each voltage tabulated is also listed.

$E_{LOG\ OUT}$	E_{OUTPUT}	R.
0	100	--
390	148	--
780	221	82
1170	329	83
1560	490	84
1950	728	85
2340	1091	86
2730	1612	87
3110	2390	88
3500	3550	89

An occasional check of anode oscillator tuning may be desirable. With Helix-Collector voltage at minimum value use an oscilloscope connected to pins B and D on output receptacle S6 to observe anode square wave operation. Vary anode amplitude, noting any unstable operation at low level. If necessary, adjust threaded screw on top of T8, the shielded transformer adjacent to V7, for a compromise between maximum output and most stable low level operation. With modulation off and voltage at maximum reset C22, the variable capacitor on the turret socket of V8, for minimum high frequency ripple.

TROUBLE SHOOTING

Should failure occur, follow a logical procedure to locate the cause. Refer, if necessary, to the Schematic Diagram and the Theory of Operation Section in this Manual.

A blown 5 ampere fuse should be replaced with a 250 volt type 3AG, 10 ampere with type 3AB.

Tubes should be observed to determine if heaters are operating and voltage regulator tubes lit. Remove and test tubes if necessary.

If V23, type 4E27A series regulator becomes gassy or if V21, type 12AX7 amplifier fails, supply output will rise to full rectifier voltage of 5 kv. Overvoltage relay RY6 will trip. This action is so rapid that it appears the high voltage is not coming on. Therefore, in the case of apparent absence of high voltage, check both V23 and V21 tubes.

Pertinent voltages indicated on Schematic Diagram may require checking. If voltages are incorrect, it is recommended that input power be disconnected from the instrument and a systematic resistance check of components be made. Any replacement of precision carbon-film resistors should be with units of identical value and tolerance.

To observe the operation of various sections of this unit, use the following check points:

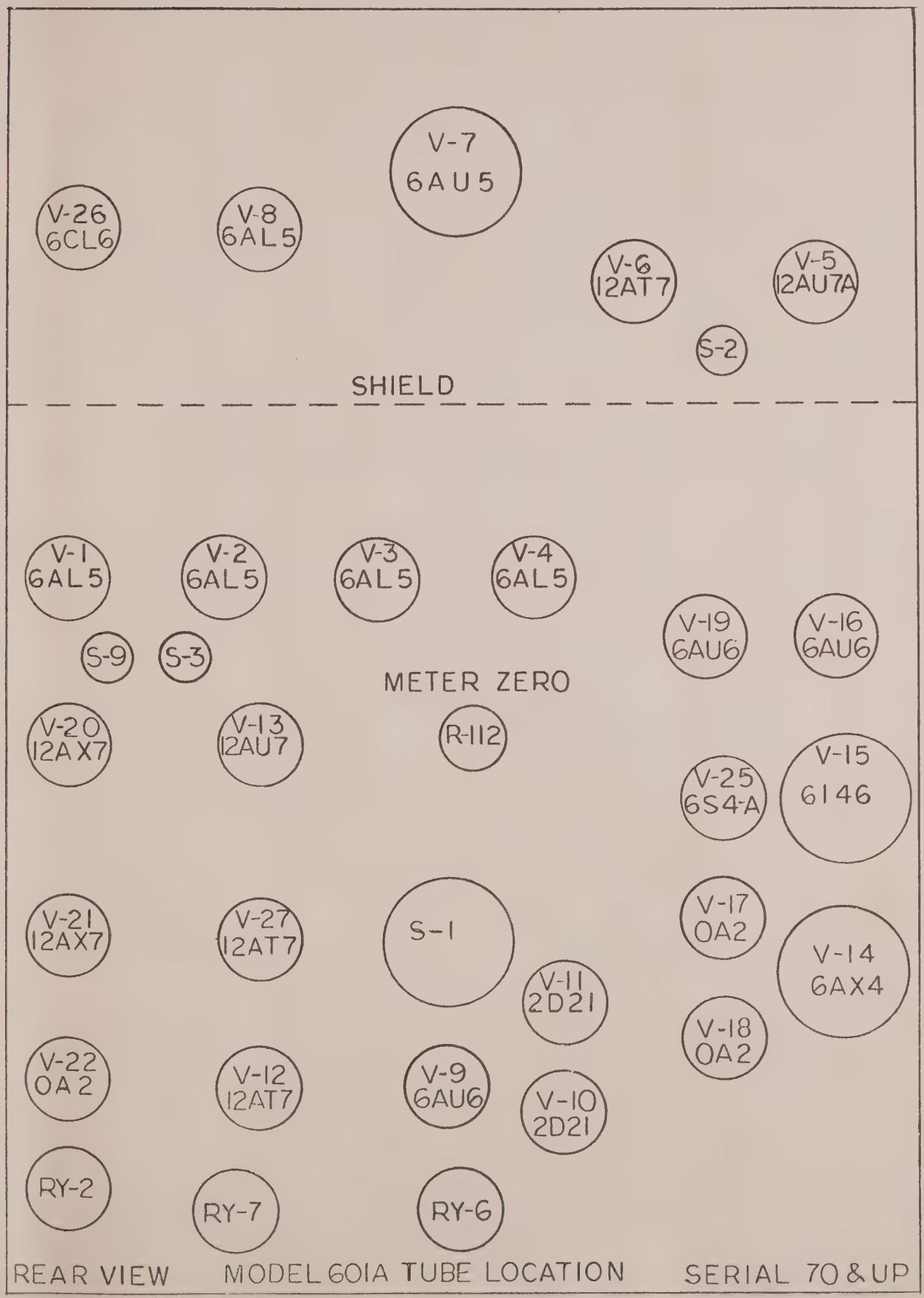
+600 volt supply	+ to V9 vector pin C - to V12 vector pin A
SHOULD BE WITHIN 1 VOLT OF −300 +300 volt supply	+ to V9 vector pin C - to V9 vector pin A (0 line)
297 - 303 1ST CHECK → −300 volt supply	- to V12 vector pin A + to V9 vector pin A (0 line)
+430 volt supply	+ to V15 pin 3 - to V? vector pin A (0 line)
-100 to 3500 volt supply	- to right hand terminal C30 + to chassis ground
Output of square wave generator V5 . .	S-2 pin 2 Return to V? vector pin E (0 line)
Output of Anode Supply	+ to V26 vector pin B
Caution: VOLTAGE control must be set at minimum, and FUNCTION switch set on DC.	- to V26 vector pin C

Output of sweep generator	+ V12 vector pin C - V9 vector pin A (0 line)
H. V. Sweep output . . . . . (at reduced level)	- at top left terminal of meter multiplier + to V9 vector pin A (0 line)

WARRANTY

All workmanship and materials except Backward Wave Oscillator Tubes are guaranteed for one year. Details concerning warranty adjustments are presented on "Shipment Damage Claim" page at the end of this Manual.

When a Backward Wave Oscillator Tube is supplied with or in the unit the BWO tube itself is guaranteed for 350 hours of use, or one year, whichever expires first. Cost of an in-warranty replacement BWO tube will be prorated according to tube life obtained or time from delivery, whichever is greater. Warranty requests should include a description of the failure, factors leading to it, and an accurate estimate of operating hours.



ALFRED ELECTRONICS
JUNE 1958

MODEL 601A
POWER SUPPLY
Serial No. 171

OUTPUT CONNECTOR

Ground	Pin A ✓
Anode	Pin B ✓
Helix	Pin C ✓
Heater - Cathode	Pin D ✓
Heater	Pin E ✓
Collector - Ground	Pin F ✓
Collector - 135 v	Pin F ✗

HEATER

E max. @ 3 amp load 10.2 v (>9.5) (R_L = 3.16 Ω, 28 w)

Panel meter @ 7.0 v output 6.95 v (6.8 - 7.2) (R_L = 3.16 Ω) △E .05 v @ 7 v, 105 to 125 line (< .12 v)

BLOWER DC

E 26.5 v @ 1 amp, 117 v input (25 - 30) (R_L = 28 Ω, 28 w)

Ripple 6.3 v pk to pk (<30% E)

BLOWER AC

E = 115 v

OK ✓

SOLENOID

E max. 103 v @ 5 amp., 115 v input (>100) (R_L = 20 Ω, 500 w)

Ripple 1.9 v pk to pk (<2)

Voltmeter @ 100 v 102 v (98 - 102)

Current meter @ 5 amp. 5.1 amp. (4.9 - 5.1)

INTERNAL SUPPLIES @ 115 v

+600 v 597 v (588 - 612)

Ripple 5 mv pk to pk (<10)

+300 v 300 v (294 - 306)

Ripple 5 mv pk to pk (<10)

-300 v 299 v (294 - 306)

Ripple 4 mv pk to pk (<10)

+430 v 435 v (420 - 440) (Anode max., Mod. off)

Ripple 3 v pk to pk (<10)

ANODE SUPPLY

Pos. S 6 Pin B

Neg. S 6 Pin D

E out (DC pos.) 2 v min. (<5)

490 v max., 5 ma load current (R_L = 90 K, 3 w) (>450)

Line reg. @ 450 v, 5 ma load, 105 v to 125 v line 9 v (<9) Anode limit pot. ✓ OK

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Ripple 4.5 (<4.5) v pk to pk @ 450 v , 5 ma.

Tuning T9 OK ✓ (optimum square wave 20 v min.)

T9 lock-nut tightened ✓ OK

Int. square wave period 1.28 (>1.25) ms min. to 0.79 (<.833) ms max.

1000 CPS centered on dial ✓ OK on time / off time = 1.04 (.95 - 1.05)

Ext. mod. (DC) (50 v square wave) ✓ OK

HELIX COLLECTOR SUPPLY Pos. chassis Neg. S6, Pin D

Noise and ripple (Anode max., mod. off) @ 3500 v, 25 ma / (<1) v pk to pk (R_L = 140 K, 87.5 w)

Current meter @ 25 ma 25.4 (24.5 - 25.5) ma

E input min. @ 3500 v, 25 ma 105 (<105) v E @ C30, 0 load, 125 v line 5.9 (<6) Kv.

@ 3500 v, 0 ma / (<1) v pk to pk

@ 250 v, 25 ma 0.4 (<1) v pk to pk (R_L = 10 K, 6 w)

4E27A plate OK ✓ @ 250 v, 25 ma

@ 100 v, 0 ma 0.5 (<1) v pk to pk

Helix (DC +60 CPS) 18 (>17) v pk to pk @ 115 v input

Helix overcurrent relay (RY2) Trips at 4.6 (4.2 - 5.5) ma

Helix current meter @ 5 ma 4.9 (4.9 - 5.1) ma

Regulation @ 100 v, 0 ma, 105 v to 125 v 50 (<500) mv

25 ma, " " " 100 (<500) mv (R_L = 4 K, 2.5 w)

0 - 25 ma, @ 115 v 100 (<500) mv

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@ 3500 v, 0 ma, 105 v to 125 v 2 v (<17)

25 ma, " " " 3 v (<17) (R_L = 140 k, 87.5 w)

0 - 25 ma, @ 115 v 3 v (<17)

Meter Calibration E out	Meter	E log out (theoretical)	E log out
100	100 (20 - 180)	0	0 (0)
148	150 (68 - 228)	390	410 (382 - ~~398~~ 420)
221	230 (141 - 301)	780	780 (764 - 796)
329	350 (249 - 409)	1170	1180 (1147 - 1193)
490	500 (410 - 570)	1560	1550 (1529 - 1591)
728	730 (648 - 808)	1950	1950 (1911 - 1989)
1091	1090 (1011 - 1171)	2340	2320 (2293 - 2387)
1612	1580 (1532 - 1692)	2730	2720 (2676 - 2784)
2390	2380 (2310 - 2470)	3110	3100 (3048 - 3172)
3550	3450 (3470 - 3630)	3500	3450 (3430 - 3570)

Lock nut tightened ✓ OK

OVERVOLTAGE RELAY RY6 OPERATION

Min. voltage trip @ 650 v (<800)

Max. voltage trip @ 3900 v (3600 - 4400)

SWEEP CIRCUIT

Sweep time (recurrent)

0.1 x 1	.102 sec. (.095 to .105)	0.1 x 10	1.06 sec. (.95 - 1.05)
1 x 1	1.03 sec. (.95 to 1.05)	1 x 10	10.07 sec. (9.5 - 10.5)
10 x 1	10.4 sec. (9.5 to 10.5)	10 x 10	102.5 sec. (95 - 105)

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Sawtooth at S1 Pin 4 140 (>130) v pk to pk

Sawtooth at S8 receptacle 11.5 (>10) v pk to pk Sine wave at S8 receptacle 18 (>18) v pk

Noise at S8 receptacle 50 (<50) mv (external sweep)

DC voltage at S8 receptacle −.9 (<±1.0) v

(Sweep on external, sweep amplitude control at 0)

Blanking 0.1 88 (>60) v 1 88 (>60) v 10 86 (>60) v pk

Single sweep release 6.50 (400 - 800) v log output

(Sweep amplitude control at max.)

Hold switch operation Up ✓ OK Down ✓ OK

E max. 3500+ (>3500) v log output

Sweep relay (RY5) operation NO ✓ OK NC ✓ OK

E out 3500+ (>3500) v @ -20 input

(Sweep amplitude control at max.)

External sweep Δ E out 10 (<100) v @ E out = 3500 v

(0 to max. sweep amplitude control)

DRIFT @ 3 Kv

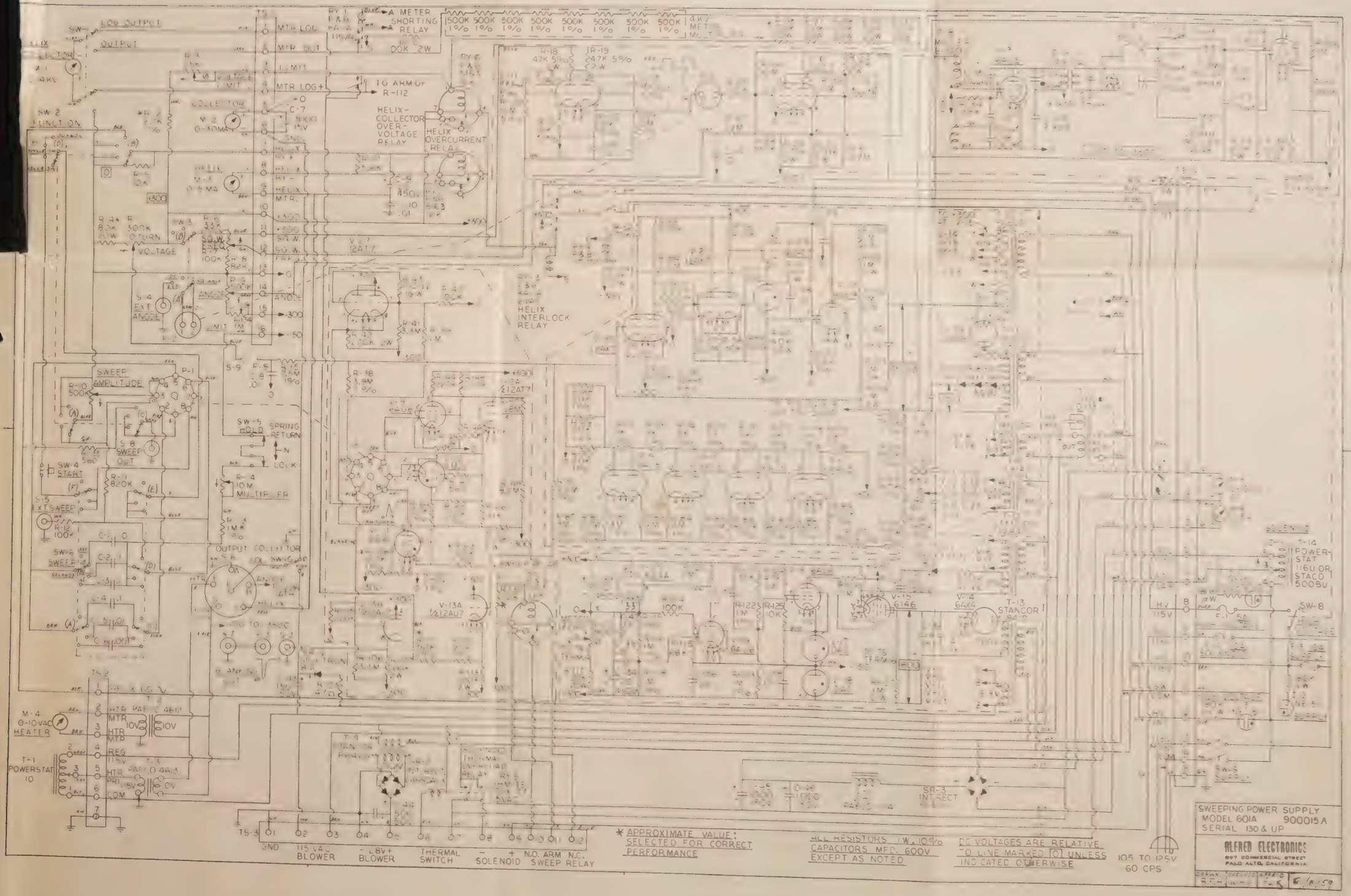
1 st. 1/2 hour 2810 2 nd. 1/2 hour 2800

2 nd. hour 2810 3 rd. hour 2820

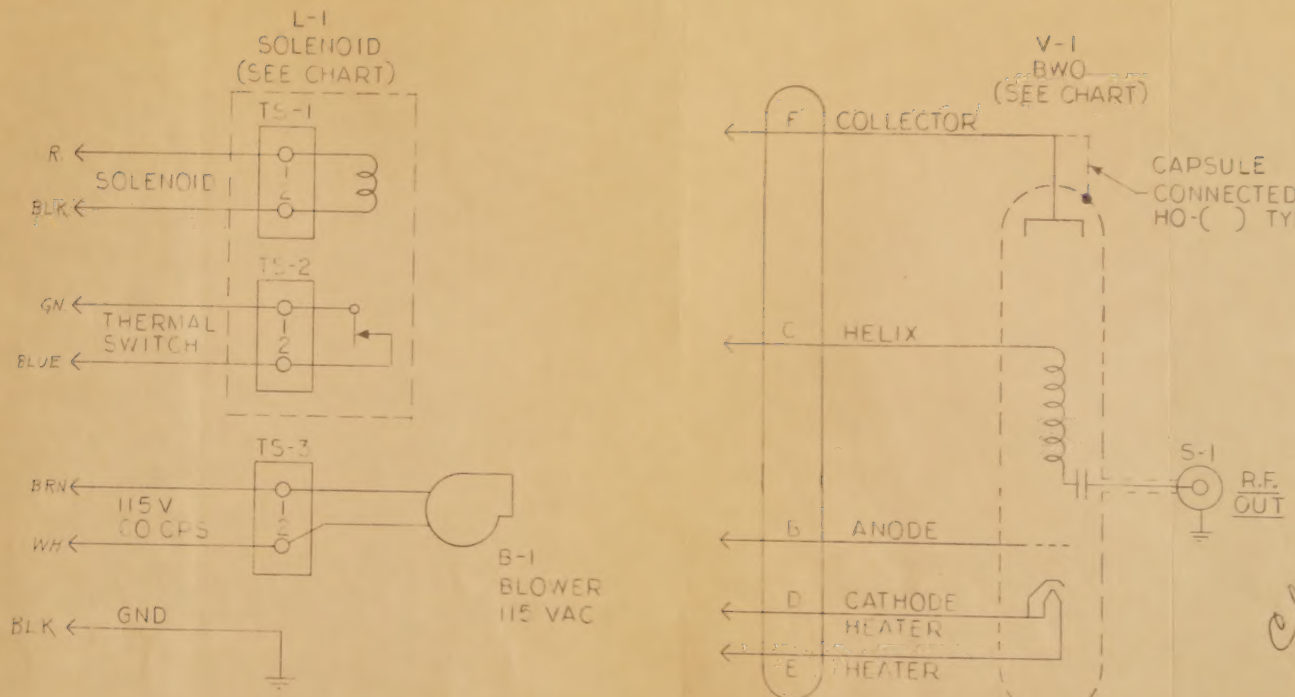
(Total drift after 1 st. 1/2 hour <100 v)

Date 1-11-60

4-29-59 Checked by W.V. - FEB - R.B. 601-D


SWEEPING POWER SUPPLY
MODEL 601A 900015A
SERIAL 130 & UP
ALFRED ELECTRONICS
897 COMMERCIAL STREET
PALO ALTO, CALIFORNIA
DRAWN R.T.H.
CHECKED W.H.H.
APPROVED F.K.S.
6/8/59
* APPROXIMATE VALUE: SELECTED FOR CORRECT PERFORMANCE
ALL RESISTORS 1W ± 10% CAPACITORS MFD. 600V EXCEPT AS NOTED
DC VOLTAGES ARE RELATIVE TO LINE MARKED ⏚ UNLESS INDICATED OTHERWISE
105 TO 125V 60 CPS
GND 115 VAC BLOWER -.8V+ BLOWER THERMAL SWITCH - + SOLENOID N.O. ARM N.C. SWEEP RELAY
A METER SHORTING RELAY
HELIX-COLLECTOR OVER-VOLTAGE RELAY
HELIX OVERCURRENT RELAY
HELIX INTERLOCK RELAY
SWEEP AMPLITUDE
SWEEP OUT
SPRING RETURN
MULTIPLIER
OUTPUT COLLECTOR
TO ARM OF R-112
V-13A 1/2 12AU7
V-15 6146
V-4 6AX4
T-13 STANCOR
T-14 POWERSTAT 116U OR STACO 500BU
SR-3 INTERCT
M-4 0-10VAC HEATER
T-1 POWERSTAT 10

BWO- S1
Serial No. ___



MODEL	L-1 SOLENOID	V-1 BWO	COLLECTOR VOLTS	FREQUENCY
BWO-L	BS-28C	5374	+155	1-2 KMC/S
BWO-S	BS-5C	HO-1AE	0	2-4 KMC/S
BWO-C1	BS-31C	111-408	+135	4-8 KMC/S
BWO-6/12	BS-3C	111-6012	+135	6.5-11.5KMC/S
BWO-X	BS-3C	111-7013	+135	8-12.4 KMC/S
BWO-P	BS-3C	HO-4AE	0	12.4-18KMC/S

Check for fuse stuffed in end of B.W.O. tube

BWO-( )
SCHEMATIC
900009 C

ALFRED ELECTRONICS
897 COMMERCIAL STREET
PALO ALTO, CALIFORNIA

DRAWN	CHECKED	APPR'D.	
E.R.B.	[illegible]	F.W.K.	7/9/59

PROPERTY OF
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